CLAIMS

1. A multi-stage process for the polymerization of olefins comprising:

(I) a first polymerization stage, wherein one or more olefins of formula CH_2=CHR, wherein R is hydrogen or a linear or branched, saturated or unsaturated C_1-C_{10} alkyl, cycloalkyl or aryl radical, are polymerized in one or more reactors, in the presence of a catalyst comprising the product of the reaction between an alkyl-Al compound and a solid component comprising at least one compound of a transition metal M^I chosen between Ti and V, and not containing M^I-π bonds, and a halide of Mg, in order to produce an olefinic polymer having porosity, expressed as percentage of voids, greater than 5%;

(II) a treatment stage, wherein the product obtained in said first polymerization stage (I) is, in any order whatever:

(a) optionally contacted with a compound capable of deactivating the catalyst used in stage (I); and

(b) contacted with a late transition metal complex, optionally in the presence of a suitable activating agent; and

(III) a second polymerization stage, wherein one or more olefinic monomers are polymerized in one or more reactors, in the presence of the product obtained from stage (II).

2. The multi-stage process according to claim 1 wherein, in stage (I), said alkyl-Al compound is a trialkyl-Al, an alkyl-Al halide or an alkyl-Al sesquichloride, said halide of Mg is $MgCl_2$ and said compound of a transition metal M^I is selected from the group consisting of halides of Ti, halo alkoxides of Ti, VCl_3, VCl_4, $VOCl_3$ and halo alkoxides of V.

3. The multi-stage process according to claim 2, wherein said compound of a transition metal M^I is selected from the group consisting of $TiCl_4$, $TiCl_3$ and halo alkoxides of the formula $Ti(OR^I)_mX_n$, wherein R^I is a C_1-C_{12} hydrocarbon radical or a -COR^I group, X is halogen and (m+n) corresponds to the oxidation state of Ti.

4. The multi-stage process according to claim 1 wherein, in stage (I), said solid component is in the form of spherical particles having a mean diameter ranging from 10 μm to 150 μm.

5. The multi-stage process according to claim 1, wherein the catalyst used in stage (I) comprises the product of the reaction between an Al-alkyl compound, an electron-donating compound (external donor) and a solid component comprising at least one compound of a transition metal M^I selected from Ti and V and not containing M^I-π bonds, a magnesium halide and an

electron-donating compound (internal donor).

6. The multi-stage process according to claim 1, wherein the porosity of the olefinic polymer obtained in the first polymerization stage (I) is greater than 10%.

7. The multi-stage process according to claim 6, wherein more than 40% of said porosity is due to pores with diameter greater than 10,000 Å.

8. The multi-stage process according to claim 1 wherein, in the treatment stage (II)(a), said compound capable of deactivating the catalyst used in stage (I) has formula $R^{IV}_{y-1}XH$, wherein R^{IV} is hydrogen or a C_1-C_{10} hydrocarbon radical, X is O, N, or S, and y corresponds to the valence of X.

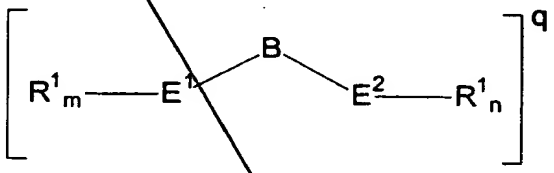
9. The multi-stage process according to claim 8, wherein said compound capable of deactivating the catalyst used in stage (I) is selected from the group consisting of H_2O, NH_3, H_2S, CO, COS, CS_2, CO_2 and O_2.

10. The multi-stage process according to claim 1 wherein, in the treatment stage (II)(b), said late transition metal complex has formula (I) or (II):

$$LMX_pX'_s \quad (I) \qquad\qquad LMA \quad (II)$$

wherein M is a metal belonging to Group 8, 9, 10 or 11 of the Periodic Table;

L is a bidentate or tridentate ligand of formula (III):



(III)

wherein:

B is a C_1-C_{50} bridging group linking E^1 and E^2, optionally containing one or more atoms belonging to Groups 13-17 of the Periodic Table;

E^1 and E^2, the same or different from each other, are elements belonging to Group 15 or 16 of the Periodic Table and are bonded to said metal M;

the substituents R^1, the same or different from each other, are selected from the group consisting of hydrogen, linear or branched, saturated or unsaturated C_1-C_{20} alkyl, C_1-C_{20} alkyliden, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkylaryl and C_7-C_{20} arylalkyl radicals, optionally containing one or more atoms belonging to groups 13-17 of the Periodic Table of the Elements (such as B, Al, Si, Ge, N, P, O, S, F and Cl atoms); or two R^1 substituents attached to the same atom E^1 or E^2 form a saturated, unsaturated or aromatic C_4-C_8 ring, having from 4 to 20 carbon atoms;

m and **n** are independently 0, 1 or 2, depending on the valence of E^1 and E^2, so to satisfy the valence number of E^1 and E^2; **q** is the charge of the bidentate or tridentate ligand so that the oxidation state of $MX_pX'_s$ or MA is satisfied, and the compound (I) or (II) is overall neutral;

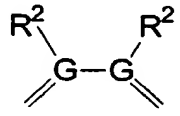
X, the same or different from each other, are monoanionic sigma ligands selected from the group consisting of hydrogen, halogen, -R, -OR, $-OSO_2CF_3$, -OCOR, -SR, $-NR_2$ and $-PR_2$ groups, wherein the R substituents are linear or branched, saturated or unsaturated, C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkylaryl or C_7-C_{20} arylalkyl radicals, optionally containing one or more atoms belonging to groups 13-17 of the Periodic Table of the Elements (new IUPAC notation), such as B, N, P, Al, Si, Ge, O, S and F atoms; or two X groups form a metallacycle ring containing from 3 to 20 carbon atoms; the substituents X are preferably the same;

X' is a coordinating ligand selected from mono-olefins and neutral Lewis bases wherein the coordinating atom is N, P, O or S;

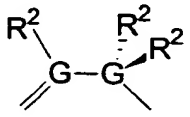
p is an integer ranging from 0 to 3, so that the final compound (I) or (II) is overall neutral;

s ranges from 0 to 3; and A is a π-allyl or a π-benzyl group.

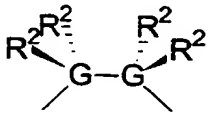
11. The multi-stage process according to claim 10, wherein said bridging group B is selected from the group consisting of:



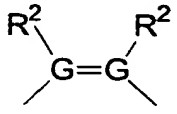
B-1



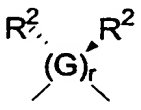
B-2



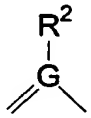
B-3



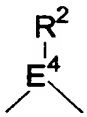
B-4



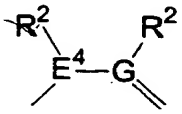
B-5



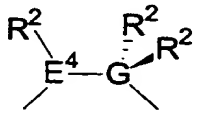
B-6



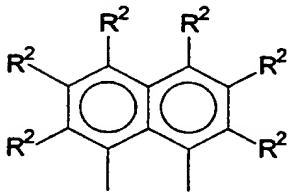
B-7



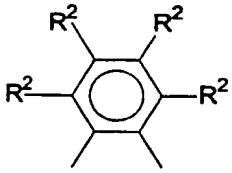
B-8



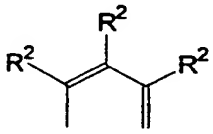
B-9



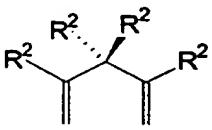
B-10



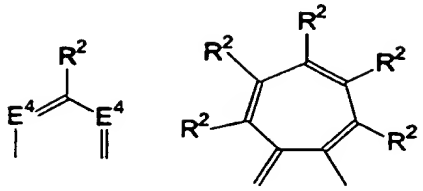
B-11



B-12

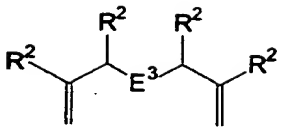


B-13

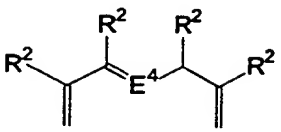


B-14

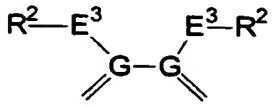
B-15



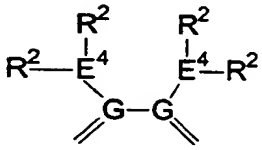
B-16



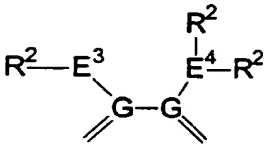
B-17



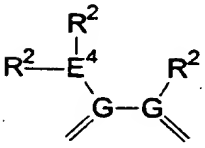
B-18



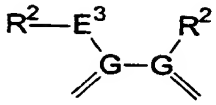
B-19



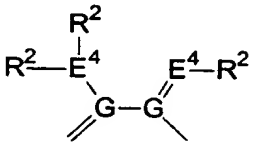
B-20



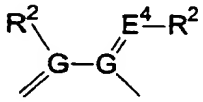
B-21



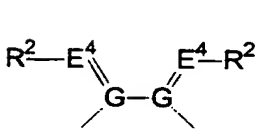
B-22



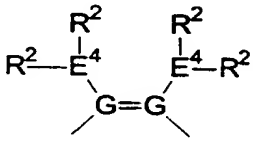
B-23



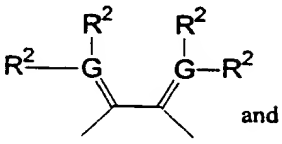
B-24



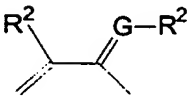
B-25



B-26



and



B-27 B-28

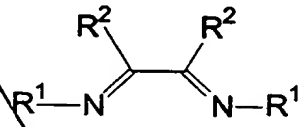
wherein G is an element belonging to Group 14 of the Periodic Table; **r** is an integer ranging from 1 to 5; E^3 is an element belonging to Group 16 and E^4 is an element belonging to Group 13 or 15 of the Periodic Table; the substituents R^2, the same or different from each other, are selected from the group consisting of hydrogen, linear or branched, saturated or unsaturated C_1-C_{20} alkyl, C_1-C_{20} alkoxy, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkylaryl and C_7-C_{20} arylalkyl radicals, optionally containing one or more atoms belonging to groups 13-17 of the Periodic Table; or two R^2 substituents form a saturated, unsaturated or aromatic C_4-C_8 ring, having from 4 to 20 carbon atoms, or they form a polycyclic ring system, optionally containing one or more Group 13-16 elements; a substituent R^1 and a substituent R^2 may form a substituted or unsubstituted, saturated, unsaturated or aromatic

C_4-C_8 ring, having from 4 to 20 carbon atoms and optionally containing one or more Group 13-16 element.

12. The multi-stage process according to claim 10, wherein E^1 and E^2 are selected from the group consisting of N, P, O, and S.

13. The multi-stage process according to claim 10, wherein the substituents R^1 are C_6-C_{20} aryl groups; the substituents X are selected from the group consisting of hydrogen, methyl, phenyl, Cl, Br and I; and **p** is 1, 2 or 3.

14. The multi-stage process according to claims 10 and 11, wherein said ligand L corresponds to formula (V):

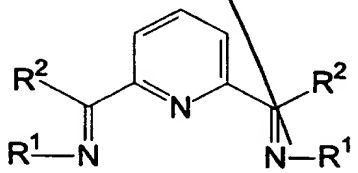


(V)

wherein R^1 and R^2 have the meaning reported in claims 10 and 11; M belongs to Group 10 of the Periodic Table; X radicals are hydrogen, methyl, Cl, Br or I; **p** is 2 or 3; and **s** is 0.

15. The multi-stage process according to claim 14, wherein the substituents R^1 are C_6-C_{20} aryl groups, optionally substituted in the 2 and 6 positions with alkyl groups containing 1 to 20 carbon atoms and/or halo groups; the substituents R^2 are selected from the group consisting of hydrogen, methyl, ethyl, n-propyl, i-propyl and benzyl, or the two substituents R^2 form together an acenaphtenquinone group.

16. The multi-stage process according to claims 10 and 11, wherein said ligand L corresponds to formula (VI):

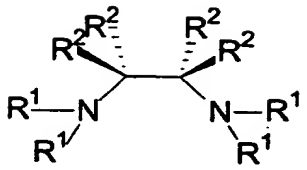


(VI)

wherein the R^1 and R^2 groups have the meaning reported in claims 10 and 11, the metal M is Fe or Co; the X radicals are preferably hydrogen, methyl, Cl Br or I; **p** is 2 or 3; and **s** is 0.

17. The multi-stage process according to claim 16, wherein the substituents R^2 are hydrogen or methyl, and the substituents R^1 are aryl rings.

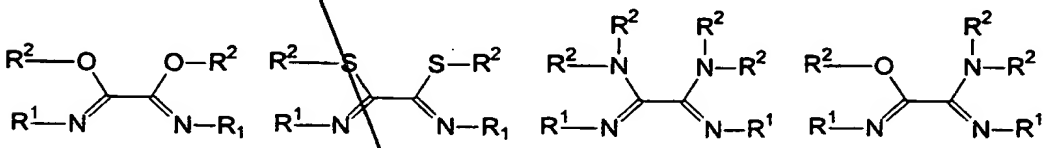
18. The multi-stage process according to claims 10 and 11, wherein said ligand L corresponds to formula (VII):



(VII)

wherein R^1 and R^2 have the meaning reported in claims 10 and 11, M belongs to group 10 of the Periodic Table, the X radicals are hydrogen, methyl, Cl, Br or I; **p** is 2 or 3; and **s** is 0.

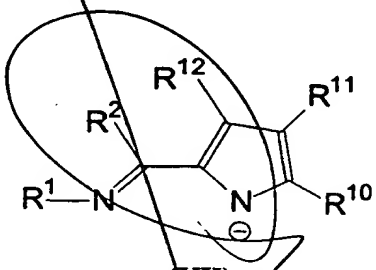
19. The multi-stage process according to claims 10 and 11, wherein said ligand L corresponds to one of formulae (VIII)-(XI):



(VIII) (IX) (X) (XI)

wherein R^1 and R^2 have the meaning reported in claims 10 and 11, M belongs to Group 10 of the Periodic Table, the X radicals are hydrogen, methyl, Cl, Br or I; **p** is 2 or 3; and **s** is 0.

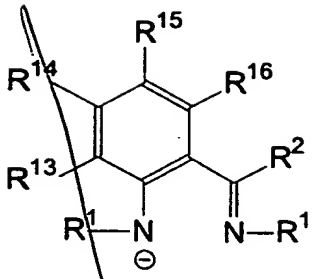
20. The multi-stage process according to claims 10 and 11, wherein said ligand L corresponds to formula (XII):



(XII)

wherein R^1 and R^2 have the meaning reported in claims 10 and 11; R^{10}-R^{12}, the same or different from each other, are selected from the group consisting of hydrogen, linear or branched, saturated or unsaturated C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkylaryl and C_7-C_{20} arylalkyl radicals, optionally containing one or more atoms belonging to groups 13-17 of the Periodic Table; or two adjacent substituents R^{10}-R^{12} form a saturated, unsaturated or aromatic C_4-C_8 ring, having from 4 to 40 carbon atoms; the metal M is preferably Fe, Co, Rh, Ni or Pd; the X radicals are hydrogen, methyl, Cl Br or I; **p** is 2 or 3; and **s** is 0.

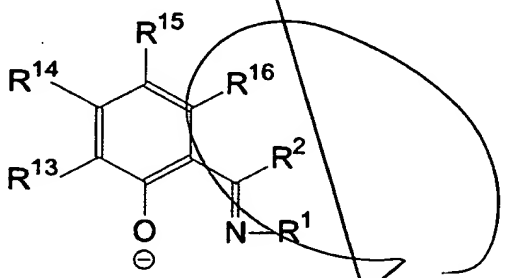
21. The multi-stage process according to claims 10 and 11, wherein said ligand L corresponds to formula (XIII):



(XIII)

wherein R^1 and R^2 have the meaning reported in claims 10 and 11; the substituents R^{14} and R^{16}, the same or different from each other, are selected from the group consisting of hydrogen, linear or branched, saturated or unsaturated C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkylaryl and C_7-C_{20} arylalkyl radicals, optionally containing one or more atoms belonging to groups 13-17 of the Periodic Table; the substituents R^{13} and R^{15}, the same or different from each other, have the same meaning of substituents R^{14} and R^{16}, optionally forming with an adjacent substituent R^{14} or R^{16} a saturated, unsaturated or aromatic C_4-C_8 ring, or they are electron withdrawing groups; the metal M is Fe, Co, Ni or Pd; the X radicals are hydrogen, methyl, Cl Br or I; p is 2 or 3; and s is 0.

22. The multi-stage process according to claims 10 and 11, wherein said ligand L corresponds to formula (XIV):



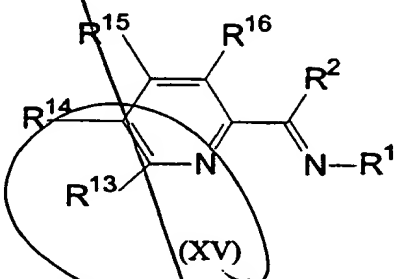
(XIV)

wherein R^1 and R^2 have the meaning reported in claims 10 and 11; R^{14} and R^{16}, the same or different from each other, are selected from the group consisting of hydrogen, linear or branched, saturated or unsaturated C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkylaryl and C_7-C_{20} arylalkyl radical, optionally containing one or more atoms belonging to groups 13-17 of the Periodic Table; R^{13} and R^{15}, the same or different from each other, have the same meaning of R^{14} and R^{16}, optionally forming with an adjacent R^{14} or R^{16} a saturated, unsaturated or aromatic C_4-C_8 ring, or they are electron withdrawing groups; the metal M belongs to Group 10 of the Periodic Table, the X radicals are hydrogen, methyl,

allyl, Cl, Br or I, A is a C_3-C_5 linear allyl, **p** is 1 and **s** is 1.

23. The multi-stage process according to claim 22 wherein, in said ligand of formula (XIV), R^1 is aryl, substituted in the 2, 6 and/or 4 positions with a substituent selected from halogen and linear or branched C_1-C_{20} alkyl groups, or is a tertiary C_3-C_6 alkyl group; R^2 is hydrogen or methyl; R^{14} and R^{16} are hydrogen, methyl or methoxy; R^{13} is selected from the group consisting of aryl, substituted in the 2 and 6 positions with branched C_3-C_{30} alkyl groups, tertiary C_3-C_6 alkyl group, $-NO_2$ and halo; and R^{15} is selected from the group consisting of aryl, tertiary C_3-C_6 alkyl group, $-NO_2$, halo, $-CF_3$, $-SO_3^-$, $-SO_2R$ and $-COO^-$.

24. The multi-stage process according to claims 10 and 11, wherein said ligand L corresponds to formula (XV):



(XV)

wherein R^1 and R^2 have the meaning reported in claims 10 and 11; the substituents R^{14} and R^{16}, the same or different from each other, are selected from the group consisting of hydrogen, linear or branched, saturated or unsaturated C_1-C_{20} alkyl, C_3-C_{20} cycloalkyl, C_6-C_{20} aryl, C_7-C_{20} alkylaryl and C_7-C_{20} arylalkyl radicals, optionally containing one or more atoms belonging to groups 13-17 of the Periodic Table; the substituents R^{13} and R^{15}, the same or different from each other, have the same meaning of substituents R^{14} and R^{16}, optionally forming with an adjacent substituent R^{14} or R^{16} a saturated, unsaturated or aromatic C_4-C_8 ring, or they are electron withdrawing groups; the metal M belongs to Group 10 of the Periodic Table; the X radicals are hydrogen, methyl, Cl, Br or I, **p** is 2 or 3, **s** is 0.

25. The multi-stage process according to claim 1 wherein, in the treatment stage (II)(b), said activating agent is an alumoxane and/or a compound able to form an alkylmetal cation.

26. The multi stage process according to claim 1 wherein, in the treatment stage (II), the product obtained in the first polymerization stage (I) is, in the following order:

(a) first contacted with said compound capable of deactivating the catalyst used in stage (I); and

(b) then contacted with said late transition metal complex, optionally in the presence of a suitable activating agent.

27. The multi-stage process according to claim 26 wherein, before step (b), any excess of said

compound capable of deactivating the catalyst used in stage (I) is removed.

28. The multi-stage process according to claim 1, wherein the polymerization stage (I) is carried out in liquid phase, said liquid phase consisting of a hydrocarbon solvent or of one or more olefins CH_2=CHR, and the polymerization stage (III) is carried out in gas phase, in at least one reactor with a fluidized bed or a mechanically-agitated bed.

29. The multi-stage process according to claim 1, wherein both polymerization stages (I) and (III) are carried out in gas phase, in reactors with a fluidized bed or a mechanically-agitated bed.

30. A catalyst component for the polymerization of olefins comprising a late transition metal complex supported on a polymeric porous support having a porosity, expressed as percentage of voids, greater than 5%.

31. A catalyst component for the polymerization of olefins comprising a late transition metal complex supported on a polymeric porous support having a porosity, expressed as percentage of voids, greater than 5%, said catalyst component being obtainable by a process comprising:

(I) a polymerization stage, wherein one or more olefins of formula CH_2=CHR, wherein R is hydrogen or a linear or branched, saturated or unsaturated C_1-C_{10} alkyl, cycloalkyl or aryl radical, in the presence of a catalyst comprising the product of the reaction between one or more alkyl-Al compounds and a solid component comprising at least one compound of a transition metal M^I chosen between Ti and V, and not containing M^I-π bonds, and a halide of Mg;

(II) a treatment stage, wherein the product obtained in the polymerization stage (I) is, in any order whatever:

(a) optionally contacted with one or more compounds capable of deactivating the catalyst used in step (I); and

(b) contacted with one or more late transition metal complexes, optionally in the presence of a suitable activating agent.

32. The catalyst component according to claim 30 or 31, wherein said late transition metal complex is supported in a quantity ranging from 1.10^{-7} to 1.10^{-1} mmol per gram of polymeric porous support.

33. The catalyst component according to claim 30 or 31, wherein said polymeric porous support has a porosity greater than 10%.

34. The catalyst component according to claim 33, wherein more than 40% of the porosity is due to pores with diameter greater than 10,000 Å.

35. A polymer composition obtainable with the process of claim 1, characterized in that:

- in said first polymerization stage a homo or copolymer of propylene is obtained, having a content of propylene units greater than 80% wt. and cold xylene soluble fractions lesser than 40% wt., said homo or copolymer of propylene consisting of 10-90 %wt. of the total amount of polymer; and
- in said second polymerization stage amorphous polyethylene is produced, having a number of total branching greater than 50 branches/1000 C, a density ranging from 0.830 and 0.880 g/cm^2, and a Tg value lesser than –30°C.

36. A polymer composition obtainable with the process of claim 1, characterized in that:
- in said first polymerization stage polyethylene, polypropylene or propylene/ethylene copolymer is produced, consisting of 10-90 %wt. of the total amount of polymer; and
- in said second polymerization stage block polyethylene is produced, having a melting point ranging from 100 to 130°C and a Tg value lesser than –30°C.

37. A polymer composition obtainable with the process of claim 1, characterized in that:
- in said first polymerization stage, a copolymer of ethylene with one or more α-olefins (LLDPE) is obtained, having a content of ethylene units of 80-99%wt., said copolymer of ethylene consisting of 10-90 %wt. of the total amount of polymer;
- in the second polymerization stage, polyethylene is produced having a number of total branching greater than 5 branches/1000 C and a density greater than 0.880 g/cm^3.